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Perceptions and expectation about Learning Analytics from a Brazilian Higher Education Institution

Citation for published version:

Pontual Falcão, T, Ferreira Mello, R, Lins Rodrigues, R, Regueira Bast Diniz, J, Tsai, Y-S & Gasevic, D
2020, Perceptions and expectation about Learning Analytics from a Brazilian Higher Education Institution. in
LAK '20: Proceedings of the Tenth International Conference on Learning Analytics & Knowledge.
Association for Computing Machinery (ACM), pp. 240-249, The 10th International Learning Analytics &
Knowledge Conference, Frankfurt, Germany, 23/03/20. <https://doi.org/10.1145/3375462>

Digital Object Identifier (DOI):

[10.1145/3375462](https://doi.org/10.1145/3375462)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

LAK '20: Proceedings of the Tenth International Conference on Learning Analytics & Knowledge

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Perceptions and Expectations about Learning Analytics from a Brazilian Higher Education Institution

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ABSTRACT

Several tools to support learning processes based on educational data have emerged from research on Learning Analytics (LA) in the last few years. These tools aim to support students and instructors in daily activities, and academic managers in making institutional decisions. Although the adoption of LA tools is spreading, the field still needs to deepen the understanding of the contexts where learning takes place, and of the views of the stakeholders involved in implementing and using these tools. In this sense, the SHEILA framework proposes a set of instruments to perform a detailed analysis of the expectations and needs of different stakeholders in higher education institutions, regarding the adoption of LA. Moreover, there is a lacuna in research on stakeholders' expectations from LA outside the Global North. Therefore, this paper reports on the findings of the application of interviews and focus groups, based on the SHEILA framework, with students and teaching staff from a Brazilian public university, to investigate their perceptions of the potential benefits and risks of using LA in higher education in the country. Findings indicate that there is a high interest in using LA for improving the learning experience, in particular, being able to provide personalized feedback, to adapt teaching practices to students' needs, and to make evidence-based pedagogical decisions. From the analysis of these perspectives, we point to opportunities for using LA in Brazilian higher education.

CCS CONCEPTS

• Applied computing → Education; Distance learning; • Social and professional topics → Computing/technology policy;

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LAK'20, March 23–27, 2020, Frankfurt, Germany
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ACM ISBN 978-1-4503-7712-6/20/03...\$15.00

<https://doi.org/10.1145/3375462.3375478>

KEYWORDS

Learning analytics; higher education institutions; human factors; qualitative research

ACM Reference format:

Taciana Pontual Falcão, Rafael Ferreira Mello, Rodrigo Lins Rodrigues, Juliana Regueira Basto Diniz, Yi-Shan Tsai, and Dragan Gašević. 2020. Perceptions and Expectations about Learning Analytics from a Brazilian Higher Education Institution. In *Proceedings of the 10th International Conference on Learning Analytics and Knowledge*, Frankfurt, Germany, March 23–27, 2020 (LAK'20), 11 pages.

<https://doi.org/10.1145/3375462.3375478>

1 INTRODUCTION

Brazilian higher education is suffering from high rates of student failure and dropout in both online and in-person contexts [21]. Universities are continually under pressure to increase their success rates and must go through stressful and time-consuming periodic accreditation evaluations, fundamental to attract students and improve their financial status. These evaluations, in general, are based on reports that take into consideration more qualitative than quantitative information due to the lack of systems to provide data in a manageable way.

The interest in Learning Analytics (LA) has grown rapidly among higher education institutions (HEIs) worldwide in the last few years [24, 29]. LA aims to use data to optimize learning and the environments where it occurs. LA is focused on students and instructors, with great potential to tackle educational challenges like student failure and dropout [8, 14]. The Society for Learning Analytics Research [14] defines Learning Analytics as the “measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs”. Based on this definition, several applications have been proposed (e.g. LA visualization [31], analysis of students trace data [13], large scale feedback provision [19]) for different course modalities (e.g. blended [17] and online [1] courses) using different types of content (e.g. trace data [13] and textual data [3]).

The adoption of LA in Brazil is still incipient compared to regions in Europe and North America. There are several studies that analyze the effectiveness of learning analytics in the Brazilian context; however, few practical implementations can actually be found in

Brazilian educational institutions [6, 15]. LA research in Brazil is focused on higher education institution as Brazilian universities often use Learning Management Systems (LMS). One factor that hinders adoption of LA is the lack of open-source tools integrated to the LMS available in Brazil [26]. The adoption of new tools generally faces financial and bureaucratic issues in the country.

Moreover, the adoption of LA is not only a matter of technological development, but is also deeply intertwined with cultural and contextual factors in the institutional community. Those must be considered to guide responsible and meaningful use of data in education [27]. Such broader perspective can improve the uptake and efficacy of LA tools, which corroborates the need for policy frameworks at the institutional level that enable more consolidated and effective solutions [10, 29]. Although there have been recent studies that aim to understand the expectations of different stakeholders from LA [28], limited research has been done worldwide, especially in developing countries [11], which have a different context and technological level of adoption comparing to Europe and North America.

Within this scenario, we aim to explore the needs and the existing capacity for adopting LA in Brazil using the research instruments that have been developed as part of the European project—SHEILA (Supporting Higher Education to Integrate Learning Analytics) [28]. In particular, this work aims to understand the perceptions, expectations, needs and concerns of students and teaching staff regarding the possible adoption of LA at their institution. We performed this investigation through focus groups and individual interviews with students and teaching staff from on-campus and online courses at a Brazilian public university. In this paper, we present the results from this field research, along with opportunities identified for the use of LA in the context investigated.

2 LEARNING ANALYTICS POLICIES

Studies conducted outside Latin America have noted cultural and social issues as threats to the uptake of LA [8, 12, 20, 25, 27, 29]. For example, two studies on the development of a LA readiness evaluation tool (LARI) [2, 18] observed the importance of the cultural factor overtaking the data factor. An Australian study [4] identified the key role of leadership in the development of institutional capacity and staff culture for LA. Based on a large-scale consultation with multi-stakeholders among European higher education institutions, Tsai et al. [29] maintain that three prominent areas of challenges related to LA adoption are (i) demand on resources, (ii) issues of ethics and privacy, and (iii) stakeholder engagement and buy-in. Various approaches have been proposed to ensure effective and ethical use of LA in the field. For example, Gašević et al. [10] highlight the importance of learning science foundations in LA design and implementation, Dawson et al. [4] and Tsai et al. [30] propose complexity leadership models to enable LA innovations being embedded into institutional operation. Dollinger and Lodge [5] emphasise a human-centred approach to involve relevant stakeholder groups in a co-creation process. Others turn the attention to the policy infrastructure in which data usage can be governed in compliance with existing data protection regulations [7, 23, 27, 29]. Among these, studies conducted as part of the SHEILA project [28] notably take an integrated approach.

The SHEILA policy framework proposed by Tsai et al. [29] considers a broad range of key factors to LA adoption, as mentioned above. This framework builds on the six dimensions of the ROMA

(RAPID Outcome Mapping Approach) model [9, 32]: (i) mapping political context, (ii) identifying key stakeholders, (iii) identifying desired behavior changes, (iv) developing engagement strategy, (v) analyzing internal capacity to effect change, and (vi) establishing monitoring and learning frameworks. The SHEILA framework extends the ROMA model with three additional elements: (i) actions, (ii) challenges, and (iii) policy. These three elements embody the collective experience of LA adoption among more than 50 European HEIs and capture a wide range of perspectives from various stakeholders including students, teaching staff, institutional leaders, and LA experts [28]. Importantly, the SHEILA framework was developed taking a human-centred and context-driven approach, which aligns with the values of the current study. As a result, we adopted the student and teaching staff focus group instruments developed as part of the SHEILA project [28] to capture the perspective of students and teaching staff regarding the use of educational data for LA.

Although the need to understand the expectations of different stakeholders from LA [28] has grown in the last few years, limited research has been done in developing countries. The LALA project¹ is an initial attempt to analyze the context of HEIs in Latin America. Within its scope, a new framework was proposed that extends SHEILA, to adapt it to the Latin American context. It is currently being used mainly by institutions in Chile and Ecuador [22]. Contributing to developing research in Latin America, the study presented in this paper is part of a wider study that aims to understand the perceptions of LA among Brazilian higher education institutions and assist the development of effective institutional policies.

3 METHOD

In this study, we aimed to answer the following research question:

Research Question 1:

What are the perceptions of students and teaching staff regarding LA in a HEI based in Brazil?

Data collection was based on the method followed by the SHEILA project, with two main adaptations: the order of topics in the discussion with students; and the inclusion of teaching assistants as participants.

3.1 Data collection instruments adapted from SHEILA

The data collection instruments from the SHEILA project (scripts with themes, questions, and prompts) were translated into Brazilian Portuguese and had their topics' order slightly adapted for the focus groups and interviews with students, as follows:

- Educational needs: thinking about the learning support that you have received from the university, is there anything that could have been done better? Would you like the university to use your background and educational data to support you?
- Purpose: what would be legitimate purposes for the university to use your data?
- Feedback: how would you like to receive feedback from the analysis of your educational data?
- Intervention: how should teaching staff approach the analysis of your data?

¹<https://www.lalapproject.org>

- **Transparency:** are you aware that your university has the ability to collect and analyze data about your actions in various learning environments?
- **Consent and ownership:** do you consider there to be any ethical or legal issues with this collection and analysis of your data?
- **Concerns:** would you have any concerns towards the way the university uses your data?

Compared to the original questions developed by the SHEILA project, the order of the topics to be discussed was modified by bringing questions about Educational needs to the beginning of the session and leaving questions about Transparency and Consent to the end. The reason for this adaptation was twofold. Firstly, LA is not a well-known area among Brazilian students. As a result, it was deemed appropriate to start a discussion on educational needs before exploring the potential uses of LA. Secondly, regulations on the use of educational data in Brazil are not as strict and transparent as in Europe. Thus, starting a conversation with topics of transparency was deemed challenging and unfruitful.

As we did not identify these issues in the SHEILA focus group questions when considering Brazilian teaching staff, the original order of topics was kept:

- **Purpose:** what would be legitimate purposes for the university to use educational data? This includes students' data and data on teaching practices.
- **Teaching needs:** what kind of data could help you improve your practice and, consequently, students' educational experience? Do you see any challenges in providing support to students? Could LA help in overcoming these challenges?
- **Ethics and Privacy:** do you see ethical or legal issues related to the use of students' data and data on teaching practices?
- **Educational support:** how could the institution use LA to improve teaching and learning?
- **Intervention:** how should teaching staff approach the analysis of students' data?
- **Concerns:** would you have any concerns related to the integration of LA to the teaching process?

These questions, along with more specific prompts, were used in the focus groups. In addition, we carried out a number of in-individual interviews using the same questions. These interviews were semi-structured, conducted mainly with teaching assistants who work for online programs and are based in different cities. Taking an individual-interview approach was due to the challenge of gathering this group of participants together. Similarly, due to the difficulty in recruiting and managing the availability of some teaching staff and students, some interviews were carried out with teaching staff and students individually instead of in a group setting. Although individual interviews lack the opportunity for peer discussion, they followed the same questions of the focus groups, thus allowing for the data to be analysed as a single corpus. In total, we carried out 8 focus groups with 31 participants, and 12 interviews.

3.2 Context and participants

Data collection was performed at one Brazilian higher education institution, where some of the authors of this paper are based. The institution offers in-person and online courses, and we chose to recruit participants from both cohorts. Instructors and students from

in-person courses have institutional access to the same (Moodle-based) Learning Management System as those from online courses, and generally use it as a support for sharing materials and facilitating complementary activities. All participants from in-person courses were based at the capital city of the state. Participants from on-line courses were scattered across the region, mostly rural areas of the state. This is because on-line courses from this institution have periodic in-person meetings that take place in a specific geographical location to which the course is officially associated. Many of these locations are in remote areas of the country to meet the purpose of Brazilian on-line public education to facilitate access to higher education in less privileged areas.

An overview of the participants is given in Table 1 (students), Table 2 (instructors) and Table 3 (teaching assistants). All teaching assistants (TAs) were from online education. Although this was not an explicit category of participant in the SHEILA project, we included them in our research as their role in Brazilian online educational is key in the learning process. In this modality, while instructors are responsible for providing instructional materials and defining course activities, TAs maintain a more direct and constant interaction with students, giving them support and feedback. In in-person courses, we do not have such a role.

Table 1: Students who took part in the research

Major (modality)	Instrument	Quantity
Computer Science (in-person)	Interview	5
Computer Science (in-person)	Focus Group	3 (1 group)
Computer Science (online)	Focus Group	5 (1 group)
Public Administration (online)	Focus Group	5 (1 group)
Linguistics (online)	Focus Group	4 (1 group)

Table 2: Instructors who took part in the research

Area (modality)	Instrument	Quantity
Computer Science (in-person)	Interview	3
Computer Science (in-person)	Focus Group	3 (1 group)
Education (in-person)	Focus Group	3 (1 group)
Humanities and CS (online)	Focus Group	8 (2 groups)

Table 3: Teaching assistants who took part in the research

Area	Instrument	Quantity
Linguistics	Interview	1
Information Systems	Interview	2
Computer Science	Interview	1

Participation in focus groups and interviews was voluntary. All the participants gave signed consent, agreeing for the data collected during these research activities to be used and published anonymously. The participants were recruited through institutional email and direct contact with course coordinators. Convenience sampling was adopted, i.e., participants were mainly recruited from student groups from the departments where the researchers are based; and teaching staff with whom some of the researchers had previously worked or known through their personal networks. As a follow-up, we want to expand participation to more departments of the university. The focus groups and interviews took place at the university and at the locations where online courses' in-person meetings are held. Interviews with teaching assistants were carried out online,

as they were based in different cities. The focus groups lasted for about an hour whereas individual interviews lasted for 20–30 min-utes. All were audio-recorded and conducted over the course of one academic year.

3.3 Data analysis

Content analysis was performed on the transcripts from the focus groups and interviews. We adopted a inductive-deductive method: firstly, we focused on exploring the predefined topics of the data collection protocols (Section 3.1). Within these topics, we took a deductive approach to identify sub-themes that emerged from data.

4 RESULTS

In this section, we present the findings from teachers', students' and teaching assistants' perspectives.

4.1 Students' perspective

In this section, we present the findings from the focus groups and interviews with students, according to the main topics discussed. The results presented in this section must be interpreted within the context investigated. All the participants are from a public university in the North-East of Brazil, a region that still suffers with poverty and little access to quality education. From August 2012, governmental policies broadened access to higher education by dedicating a fixed amount of vacancies for students from public schools (low-income) through the "Quota Law" (Law 12.711). In parallel, online courses were created with in-person meetings taking place in remote areas in the countryside, opening up opportunities for many people who had never imagined accessing university. While this represented a turning point in the country's history, it also created new challenges as the students entering university have now basic needs related to gaps in their basic education. Effects of these gaps and needs emerged from the focus groups and interviews with students and are discussed within the categories that follow.

4.1.1 Educational needs. Within this topic, subthemes were identified and are discussed separately.

a) Use of the LMS: Low learnability and usability of the LMS Moodle (version 2.7) was a hot topic in the focus groups. The majority of students had no prior knowledge of the LMS when arriving at the university, and they generally found it hard to use. Students complained about the lack of support for using the LMS, and admitted much difficulty to learn how to use it. The lack of training to use the LMS itself implies an institutional assumption that students will learn to use the environment on their own. However, in many cases, students finish their degrees without having mastered the system. One student of the Public Administration major said during the focus group that she only realized that she had failed an online course two terms later, because she "didn't know how to use the LMS and didn't notice the information."

The organization of information in the LMS was particularly criticized by students, such as the lack of separation between past and present courses in addition to unclear order of the courses that students have taken. Although the sorting of the course list could be customized, the functionality was not easily perceived and remained unknown to most students. Another complaint refers to the forums, where information gets lost in the high volume of questions and answers. Access to private messages is also difficult to find, and most students did not know how to configure the system, for

example, to receive (or not receive) notifications for LMS messages. "I receive private messages for any post any student makes in the forums. I have now 240 unread messages. I fear that if I try and change the configurations, I might miss something the instructors send (focus group participant from Public Administration)" It is important to note that students may enter the university (including Computer Science majors) with very limited digital skills, and there are students from online courses who do not have a computer at home: "I did not have a computer when I entered the university, and it was very hard to depend on the university's resources. I missed many assignments and I even thought of giving up (focus group participant from Public Administration)."

b) Communication with teaching staff: Another aspect brought up by the students relates to the interactions with teaching staff. Students feel the need of receiving reminders from the teaching staff about upcoming deadlines, as well as messages when they miss them. Such messages motivate students to work towards their learning goals and builds a rapport between teaching staff and students. They also reinforce students' sense of commitment to the university, especially for online students who tend to work full-time while managing family responsibilities and studies. As a result, students also expressed the stress of being overwhelmed by workload and hence an inclination to choose courses that appear to be easy to master or pass.

The medium used to deliver these messages and reminders has a key role in reaching the students. Once again, the students perceived the LMS as a problematic platform for sending messages, as few students used the mobile LMS application on their smart-phones (either for the lack of knowledge about it, or for the lack of interest). Moreover, using the LMS on laptops or desktop computers demands dedicated time and specific infrastructure: "To see if there's feedback, I need to access the course, find the week, then the assignment, open it, it's such a bureaucracy, I even feel lazy to do it. So I don't look it up, what for? It takes too long, I'm losing my time. I want something easy (student in Public Administration, in a focus group)." The students prefer to receive communications from teaching staff via WhatsApp – an instant messaging mobile application that has become ubiquitous in Brazil – because "it's easy to use and you check it anytime and anywhere, even at work (student in Linguistics, in a focus group)." The students also like the informality of the communication via WhatsApp, which makes them feel more at ease to speak with the teaching staff. They find email communication too formal and intimidating. Instead, students prefer the "social network language": "The environment is too formal. It makes us fear getting in touch with the teaching staff. What if they don't like it? I don't feel that I can reach out to them, so I don't ask them questions, even when I have them (focus group participant from Public Administration)."

The students also found themselves highly self-conscious about posting messages in forums, to the point of avoiding forum activities entirely due to the lack of confidence in posting responses publicly, despite knowing that this would lead to the loss of marks. On the other hand, some students did make use of the LMS communication tools, but they were disappointed to see a lack of responses from peers and teaching staff.

c) Educational resources: In addition to the difficulties in interaction through the LMS, the students also pointed out that educational resources need to be improved with regard to: the diversity of media (there is too much text and few videos where oral explanations

were found to be helpful) and the quality of the handouts (several of which are outdated, but teaching staff are not allowed to make changes as they are institutional material). “Most materials are handouts and books, but nobody learns just from reading. I learn better when I listen. If the teaching staff can't make a video, they could send at least an audio with explanations—it would be very helpful (focus group participant from the Public Administration major).”; “Sometimes you read and read and read... and don't understand. Then you find a related video on YouTube and you get it easily. Teaching staff ask us to record videos, but they don't want to do it themselves (focus group participant from Linguistics).”

d) Socio-economic conditions: Some students live in isolated areas with poor Internet connection, and this can prevent them from submitting assignments in due time. Therefore, they believed that there should be more flexibility with deadlines. On the other hand, socio-economic conditions were also seen as external aspects that the institution cannot control, and it would be unfair to impose on the teaching staff the obligation to take action if notified of students at-risk, as solutions to students' failure or dropout require more than the teaching staff's support alone.

e) Opinions on how to use data: Following the SHEILA instrument, students were asked about the following examples of uses the university could make of their background and educational data to support their learning:

- To improve your relationships with teaching staff.
- To improve your overall learning experience and well-being.
- To identify weaknesses in your learning and suggest ways to improve upon this.
- To alert teaching staff early if you are at-risk of failing a module or if you could improve your learning.
- To identify the optimal pathway through your studies.
- To present you with a complete profile of your learning in each and every module.

The most desirable usage highlighted by the students was: ‘To present you with a complete profile of your learning in each and every module.’ Although some participants also wished to have their data be used to identify weaknesses in their learning and suggest ways to improve upon this, other participants held contrary attitudes as they believed that students should take more responsibility of their own learning and be more proactive. For example, one student in Computer Science who took part in the focus group suggested that “the teaching staff will not guess that you have difficulties, you must let them know.” ‘Identify the optimum pathway through your studies’ was also cited, although some students thought this is too hard to be done automatically and that students should know better about how to conduct their own studies.

4.1.2 Purposes of using LA. Improving the learning experience, both at the individual (student) level, and at the course level, was the main perceived benefit of using LA, from the students' perspective. This includes generating statistics about the course using students' grades and dropout indexes; analyzing several aspects of students' low achievement to find out the reasons for poor learning outcomes, and creating potential solutions. Shifting the focus from the students' performance to the course structure itself, the students suggested using LA to identify the most adequate pedagogical methods and educational resources for specific disciplines. They believed that this could be done by comparing students' performances which resulted from different pedagogical methods and/or

learning resources, and selecting those that led to better learning outcomes. The profile of the instructors could also be analyzed, to identify teaching methods that better suit specific disciplines.

More specifically, students from online courses would like the use of LA to keep them better informed and organized, as existing communication is ineffective, resulting in a sense of isolation and loss of directions among students.

4.1.3 Feedback and Intervention. The students found that grades-only feedback did not help them improve their work as they were not able to identify their errors and weakness. The students indicated that not all the teaching staff used the field for comments available in the LMS to provide feedback on assignments, and suggested that the university embed standard feedback comments in the LMS for teaching staff to choose from and to include along with the grades for students.

The students also highlighted the importance of early, iterative, personalized feedback. As teaching staff often only provide feedback after the assignment has been submitted for grading, students cannot clarify emerging doubts while working on the assignments. The students reported that their questions posted in the LMS were often left unanswered. In cases where the questions were answered, it was often too late to act. Another issue pointed by the students is the lack of personalised feedback in cases where the teaching staff replicated written explanations from the textbooks and hand-outs when answering students' questions, which, according to the students, did not help them learn. In general, the students found existing feedback too generic. They also indicated a lack of transparency as to how their work was evaluated.

The students showed aversion to the idea of being presented with ranked data of their achievements compared to peers. This is due to the likelihood of embarrassment and demotivation as a result of the public comparison: “this could convey the impression of depreciating the low achievers;” “students could feel bad because of some aspect which might not even be that important in defining them as a good or bad student.” Some also indicated that ranking introduces an unnecessary component of competition, and others believed that students would be aware of their performance and therefore did not need a ranked comparison.

The views about improving feedback, making it more frequent, personal and specific, were unanimous among the students. An idea for doing this was the system suggesting exercises based on students' performance. Some students suggested that socio-economic data could be used to group students and give automatic personalized feedback. For example, for students coming from public schools, the system could recommend more mathematical exercises, as these students were perceived to have learning difficulties in this discipline. This suggestion, however, led to much debate in the focus groups, as some students considered the use of social indicators in informing interventions to be discriminatory.

4.1.4 Transparency, Consent and Concerns. None of the students remembered having signed any kind of authorization for the university to make use of their data when they enrolled. Neither did they envision risks or worry about the possible uses of their data by the university. In general, the students did not perceive situations in which they would refuse to have their data accessed by the university. The students indicated that these issues were not something they paid particular attention to. They also believed that there was implicit consent, as they enrolled, that the university

would have access to their data. The students understood that their data was ubiquitous, particularly in social networks, and believed that educational data possessed by the university was not overly sensitive. However, the students also expressed an expectation of the university to treat their data anonymously.

4.2 Instructors' perspective

4.2.1 Purpose for using LA. Overall purposes cited by the instructors for the use of LA were: decrease students dropout; improve their own teaching; improve students' learning; and establish good institutional practices and policies. More specifically, instructors believe that the use of educational data could allow them to constantly evaluate their practice, adapting their planning through evidence-based decisions. This also includes giving more personalized guidance and feedback for students.

4.2.2 Teaching needs. Instructors would very much like to have more visibility of students' progress and needs. They would like to be able to identify problems that today are "invisible," or "in between lines" (their words), i.e. although the data are available in the learning systems, there are no tools that allow them to be properly interpreted. Accessing and interpreting data from Moodle and other academic systems is a slow and complex process. Reports are mostly based on spreadsheets and hard to understand, with no analysis that considers different types and sources of data. Personalization in the teaching-learning process is a general desire, but still seems unattainable. One instructor from Education declared in a focus group: "Personalization is something we really wish for. But, in a class with 60 students, how do I personalize, within the classroom dynamics, during 4 hours? As much as we may try to personalize teaching, at the end of the day, the course's objectives are general and must be attained by all". Four subthemes emerged from the discussions as to how LA could help overcome these challenges.

a) Kinds of data: The instructors cited several types of data that would be of interest. More commonplace types of data were cited, such as frequency of students' access to the LMS; time spent online; downloads of material; and demographic / socioeconomic data (gender, ethnicity, age, full-time or part-time student, familiarity with technology, access to computers or smartphones). Other types of data, that can be more complex to obtain, were also cited, namely: most accessed type of material (e.g., video, text, and slides); time spent by students reading a text; amount of text produced in an activity; quality of written content; order in which activities were performed; academic trajectory of the student (including competencies and course failures); students' performance by knowledge area; students' performance by type of activity; learning styles. The instructors also mentioned that students' opinions could be collected through evaluation forms.

b) Relevant information from the data: More than merely citing types of data, the instructors discussed the related educational goals. They are very interested in knowing the effectiveness of activities they propose, which could be analysed, from their point of view, in terms of students' behavior. However this behavior can be quite complex to analyze, as instructors themselves recognize: "There needs to be a transposition from what is detectable in the LMS to actions towards learning improvement. There are various psycho-logical constructs involved in this mapping and it's not that simple. How do we transform objective data in a correct conclusion about a student? Which theoretical framework will back up this decision? (instructor from Humanities, participant in a focus group)". In this

sense, instructors argued that simply knowing if a student was online for a certain time, or downloaded the material, is of little use, as they do not know if the student learned from it, or what the student actually did during their time online. When it comes to achievement and performance, the instructors would like to know much more than grades: they are interested in knowing which content topics are difficult to learn for a certain student and/or group of students, and pinpointing the topics that students should but have not learned. These difficulties should also be interpreted within the context to where the student belongs, considering aspects like the infrastructure of the geographical region; the characteristics of the students' group in that region (habits, routine, profile, etc.). The instructors also suggested that a set of types of data could allow identifying good teaching practices to be disseminated. Last but not least, the instructors were extremely interested in understanding what sparkles students' motivation and make them engaged in the course activities, whether these are tools, certain kinds of activities or materials, themes, etc. This, of course, varies per student groups, and even within groups.

c) Data visualization: The instructors highlighted the importance of adequate ways of visualizing the data collected: visualization should be simple, objective, and as succinct as possible. It should also be multimodal, and responsive (i.e., adapted to different platforms and screens). Charts, word clouds and clusters were some of the visualization options cited. From the visualization presented, the instructors would like to be able to easily perceive actions that should be taken. They would also like the visualizations to be dynamic and flexible – in other words, they would like to be able to customize their interface and set priorities (which kind of data they would like to view and how).

d) Recommendations: More than just access to information, the instructors would like to be provided with flags alerting students at risk, recommendations of actions to take, and suggestions of activities and approaches, based on the information collected: "What is the instructor going to do with all the data in hand? A spreadsheet indicating student's time online is useless, it's hard to understand the meaning behind it and infer what can be done. Overwhelming the instructor with information might not be the best strategy (instructor from Humanities participant in a focus group)."

The instructors also mentioned that students should also receive suggestions in these cases (e.g. on how to conduct their studies), as improving learning should be a joint effort of teaching staff and students, and not only the teaching staff's responsibility.

4.2.3 Ethics and Privacy. The instructors think that there is a risk of excessive intrusion in students' learning routines, as more data about their actions in the virtual environments are collected, and related feedback is given, potentially leading to discomfort due to excess of control. It is important to make sure that enough private space is given to the student, and that no student is ever publicly exposed. The instructors mentioned that it would be important to have students give informed consent for the data collection while they were enrolled, but they were unsure about the level of detail needed in the consent form: "the main thing is to understand what we gain from a piece of information and reflect if it's worth to collect and make available. Every piece of information can be used for good or bad (instructor from Humanities, participant in a focus group)"; "There is a fuzzy boundary when data cease to be used for academic purposes and start to be used for control."

The law department must be involved (instructors from Education, participant in a focus group)". Another issue that arises from the consent forms are cases of students who refuse to give consent.

The instructors also discussed their own privacy, and agreed that a strong cultural aspect in Brazilian public higher education was that, traditionally, instructors were not comfortable being super-vised or evaluated in any way. Thus, ethical conflicts are bound to emerge among staff, due to LA methods which "invade" instructors' space that at present is private. The risk of excessive control of instructors' work was also mentioned, representing a threat to their autonomy. This issue gained particular attention due to the political situation of the country, which is currently under a more authoritarian government which has been clashing with public HEIs. One instructor from Computer Science declared, in a focus group: "Data can be used against the teaching staff. For example, if students aren't accessing the environment or are presenting low levels of achievement, the instructor can be irresponsibly pointed as 'guilty', the data can be taken as 'the truth' about that instructor's practice". For reasons like this, the instructors believed it would be important to have clear institutional rules to regulate the use of LA.

4.2.4 Educational support. Following the SHEILA instrument, the instructors were asked about the following examples of uses the university could make of LA to support teaching and learning:

- To improve relationships with students.
- To improve the overall learning experience and students' well-being.
- To identify weaknesses in students' learning and suggest ways to improve upon this.
- To alert teaching staff early if students are at-risk of failing a module or in need to improve their learning.
- To identify the optimal pathway for students to reach their learning goals.
- To present instructors with a complete profile of students.
- To present instructors with a complete profile of students' learning per course module.
- To present instructors with a profile of their teaching practices and how they influence students' engagement.

The most important uses, according to the instructors, were: "to present instructors with a complete profile of students;" "to present instructors with a complete profile of students' learning per course module;" "to identify weaknesses in students' learning and suggest ways to improve upon this;" and "to alert teaching staff early if students are at-risk of failing a module or in need to improve their learning." On a second level of importance, the instructors indicated "To present teaching staff with a profile of their teaching practices and how they influence students' engagement;" and "to identify the optimal pathway for students to reach their learning goals." Finally, the instructors considered that all these actions should naturally lead to improving relationships with students and the overall learning experience and well-being.

4.2.5 Intervention. The instructors agreed that, whether using LA or not, they had the general obligation to take action when difficulties in students' learning were identified. However, with the adoption of LA, the instructors may be faced with the need to completely change their method, or totally reformulate their material, which is challenging and time-consuming. Additionally, the instructors may not know how to interpret the data, and if

under pressure, they may take inappropriate decisions. Within this scenario, the instructors argued that they should keep their right to autonomy, and should not be obliged to take actions for every specific situation that the data might indicate. On the other hand, the institution should provide training for instructors to learn how to use the tools and how to interpret data: "Data may not be easy to read, so some preparation is needed. The person will think: what am I gonna do with this?? (instructor from Information Systems, participating in a focus group)"; "Today we have the argument that there is no access to data, there are no proper tools, analysis is manual and there is not much we can do. But from the moment that data is made available, people need guidance about what to do with it, and about their new obligations (instructor from Humanities, participating in a focus group)."

4.2.6 Concerns. The instructors highlighted the risk of excessive labelling of students (as high or low-achievers, for example). They worry that this can have a negative impact on students that are going through difficulties, but that could improve at a later time. The LA approaches must make sure to be dynamic enough to detect these changes in performance and behavior. Another concern relates to how LA methods could help reaching students who might barely access the LMS, and/or not interact at all. Despite seeing the benefits of LA, the instructors believed that their workload would increase, and that some would resist change, opting for remaining in their comfort zone. Another concern was that they believed the higher amount of information on teaching and learning would increase criticism on instructors' work, and many were not prepared to receive negative feedback. They also feared that the institution, at higher administrative levels, may be led to precipitate decisions based on data that can be decontextualized, without giving a chance for the instructors to argue. All in all, the instructors stressed the importance of guaranteeing that reasonable and responsible use was made of the data collected.

4.3 Teaching assistants' perspective

The SHEILA framework does not mention teaching assistants (TAs) as a specific category of interviewees. However, in Brazilian online education, TAs have a very important role, and for this reason were invited to participate. In Brazilian online education, TAs are responsible for most of the interaction and communication with students, giving feedback on activities and answering students' questions. Probably due to this proximity with students, TAs' discourse had a lot in common with students' opinions.

4.3.1 Purpose. The TAs cited as main purpose for using LA improving the learning experience (particularly through personalization). They would like to have a better understanding of each student's situation to improve students' learning and decrease dropout. Another potential use mentioned was at the institutional level, to evaluate courses curriculum and improve institutional services in general.

4.3.2 Teaching needs. Four subthemes were identified from the TAs declared needs, discussed next.

a) **Personalized feedback:** The TAs shared the instructors' desire to be able to deliver more personalized support and feedback. For example, it is hard for them to deal with students' groups with considerable variation in their level of competences. Like the instructors, they mentioned that although the data is in the LMS, accessing it at present is hard and costly. In many cases, Moodle

reports must be manually transported to spreadsheets that TAs customize to be able to accompany students' progress. The TAs gave particular importance to demographic and socioeconomic data, in order to be able to understand each student's context and adapt activities, deadlines and means of communication to different needs and routines. They also highlighted the need for humanized feedback, which can help with students' emotional and psychological issues: "they are not numbers, they're people. We need to be kind and establish dialogue (TA from Information Systems interviewed)." However, they say that nowadays it is not feasible to do this, as there are no tools to help, and few TAs for large numbers of students.

b) Communication and Interaction: A hot topic discussed by the TAs was the difficulty in communication and interaction with students. Messages sent by TAs through the LMS are generally left unanswered. One of the reasons for this is that notifications of messages sent through the LMS frequently are not delivered to students' emails. While students hardly communicate through messaging and chat tools available in the Moodle LMS, they seek TAs help through mobile application tools (mainly Whatsapp). This is problematic for being off institutional boundaries, and no information exchanged through unofficial channels can be considered for evaluation. It is an individual decision of the TA to accept to communicate via unofficial channels, with no institutional support: "The student may go this way and treat all course-related matters through other channels, totally forgetting about the LMS (TA from Linguistics interviewed)." Additionally, the TAs mentioned that students are self-conscious to openly participate in the LMS. They say forums are not dynamic and interaction is very slow, limited or non-existent. There should be some way to attract students and promote more interaction in the LMS.

c) LMS tools and usability: The poor interface and usability of the Moodle LMS were cited as causes for students' disengagement and TAs difficulties to propose activities: "Within the LMS, as much as we try to stay in touch, students do not correspond. It seems that there is something missing to attract the students to the environment (TA from Information Systems interviewed)"; "it's important that the LMS has a better look so that things happen within it (TA from Linguistics)". Although the TAs recognize that there are diverse and powerful tools available in the Moodle platform, they find them hard to learn and use, and with poor interface. Moreover, a lot of the desired information must be collected manually. In particular, the TAs mentioned the lack of good tools for giving feedback and support to students. For example, a TA said he used Google Hangout to share his screen with students and give demonstrations of problem solving. He also used Google documents to give feedback on written activities, as he could track changes and make comments, facilitating students' comprehension of their errors and aspects to improve. Another challenge mentioned by TAs was their limited permissions within the LMS. For example, they cannot install plug-ins and they have a limited view of students' profiles.

d) Kinds of data and Relevant information: Besides common data related to students' profile and their access and activity in the LMS, more specific needs emerged: indicating which students did not submit activities by the due date; identifying submitted files that are empty (uploaded only to meet the deadline); and identifying plagiarism. They also mentioned, like the instructors, the importance of assessing the content and quality of text produced. For example,

in forums, students sometimes post similar pieces of information only changing the words, but do not effectively engage in the debate. The TAs would also like to know the level of competence and knowledge of each student in a discipline. Another aspect cited was to identify courses that cause disengagement, and a diagnosis of the effects of specific teaching methods on students' engagement and achievement.

4.3.3 Ethics and Privacy. The issue of students' and teaching staff's privacy also came up, including risks of political persecution. The need for institutional regulations by an ethics council was also mentioned. On the other hand, the TAs believe that strict use of educational data, for educational purposes, present little ethical risk. In order to guarantee proper use of data, there should be restricted access of different user profiles (e.g., students, instructors and teaching assistants) to different kinds of data. For example, socioeconomic data should not be broadly available.

4.3.4 Educational support. The most important uses, according to the TAs, were: "to identify weaknesses in students' learning and suggest ways to improve upon this;" and "to alert teaching staff early if students are at-risk of failing a module or in need to improve their learning." In a second level of importance: "to present instructors with a complete profile of students;" "To present instructors with a profile of their teaching practices and how they influence students' engagement;" "to identify the optimal pathway for students to reach their learning goals;" and "to improve relationships with students and the overall learning experience and well-being."

4.3.5 Intervention. The TAs agree with the instructors that there should be no obligation to act upon all new information provided by LA tools. They believe that teaching staff should try to address as many issues as possible to improve the learning experience, but they cannot be formally obliged to act upon them all. They also agree with the instructors that training is essential, and must be given to all teaching staff expected to deal with LA.

4.3.6 Concerns. The TAs mentioned it might not be easy to meet students' needs and preferences, even having the support of LA, as in many cases the intervention per se would have to be manual and/or individual. Also, it could involve the production of specific types of material. For example, the TAs noticed students' preference for videos, but producing this kind of material can be hard, costly and time-consuming. The institution itself has limited infrastructure to support teaching staff with this task. Similar to the instructors, the TAs worry about reaching students that are hardly ever online. They reported cases of students that only interact at the in-person periodical meetings. In these cases, the TAs depend on the assistant that is responsible for conducting these meetings to obtain information about the student or get in touch with them. They say many students lack the maturity to take an online degree. The increase of workload was also a matter of concern for the TAs, especially as they earn lower hourly wages than instructors. They also believe there would be resistance to change from teaching staff.

5 DISCUSSION

5.1 Comparison of Stakeholder Views

Improving the learning experience was the main purpose of LA indicated by the three categories of participants. Students and teaching staff all expressed the desire for more personalized support and feedback, particularly considering students' individual context and

specific needs. Personalization was a keyword in the discourse of all participants, highly desirable but yet perceived as mostly unattainable. The importance of taking into account students' socio-economic conditions within the educational process, for defining types of activities, forms of evaluation and ways of communication, was clear in all participants' discourse, reflecting the impact that Brazilian social inequalities still have on students' basic competencies and on their access to required infrastructure.

Aligned with these aspects, when prompted with possible uses of LA, the students and instructors chose the "presentation of a complete profile of students' learning" as the most important. The teaching staff (both instructors and teaching assistants) and students also agreed on the importance of "identifying weaknesses in students' learning and suggesting ways to improve upon this". The teaching staff also indicated as very relevant "being alerted early about students at-risk". More specifically, and in coherence with these choices, the instructors were interested in being able to make more evidence-based pedagogical decisions within a constant evaluation process of their own practice. This is consonant with the students' wishes for analyses on the adequacy of teaching methods and approaches for different disciplines. In particular, the instructors would like to know the specific weaknesses in students' expected knowledge, the effectiveness of the activities they propose, and the level of student engagement these activities entail. The teaching staff would like to be able to visualize such kind of information easily, through simple multimodal interfaces, which should also show alerts and recommendations. These are ways the instructors suggested for mitigating the risk of increased workload from the introduction of LA methods, besides having ample training offered by the institution (which was also an opinion of TAs).

The teaching staff agreed that acting upon data received from these new methods should not be an obligation, as instructors' autonomy should be respected, but that all teaching staff should be encouraged to seek constant improvement in their practice, which already is a general rule of thumb.

Interestingly, the students and TAs had very similar views on the low learnability and usability of Moodle platforms, and communication issues through the LMS. The popularity of the mobile messaging application Whatsapp in Brazil emerged from their discourse. While the students clearly prefer this type of communication channel, the TAs worry about going off institutional boundaries and losing control of the process. However, they agree that communication and interaction through the LMS has proved highly ineffective, which is a constant source of frustration for the TAs.

Among the participants, the instructors were the most concerned with ethical issues, while students were hardly able to envision any problems. The instructors worried about excessive intrusion in the students' privacy and their own. The political situation of the country since the last national elections (in 2018) may have contributed to their fear about authoritarian institutional control of their work and even the possibility of political persecution based on decontextualized data collected automatically. Another concern presented by the instructors, that could be a barrier for the acceptance of LA methods, relates to the general discomfort they feel when having their practice constantly evaluated and criticized – this was mentioned by the teaching staff as a typically Brazilian cultural trait that must be surpassed.

5.2 Implications

The LA policy development process proposed by the SHEILA project focuses on integrating multi-stakeholder perspectives. Following this approach, we envision educational interventions and solutions for some of the educational challenges identified. From the results presented, we propose a set of opportunities for the application of LA techniques and tools, based on the needs of the three groups of stakeholders.

- LMS interface: Given the difficulty of using and learning to use the LMS, LA could provide adaptive interfaces based on the analysis of student profile as a frequent or infrequent user, and facilitate interactive support accordingly.
- Visualization of learning processes: Considering that some students require more guidance in organising their studies and frequent feedback on their progress, LA tools could be used to generate dashboards where students can monitor their progress compared to learning goals, and access information about the planned activities.
- Online discussions: In online courses, forums are designed for interaction among students. However, as some students confirmed, it is difficult to keep up with all the posted messages. LA could be used to provide assistance to students and instructors, by classifying messages by themes and levels of urgency. For example, the LA-based Starburst tool [16] could be used to address this problem and help students navigate discussion forums.
- Student background recognition: LA could be used to identify the students' level of knowledge and provide personalized content in order to reinforce their learning. LA could also be used to identify students that require additional support. However, special caution should be taken to avoid exposing individuals or discrimination against students from particular social backgrounds.
- Identification of students' strategies: Identification of actions within the environment that could implicate in the students' performance. This information is useful to promote self-regulated learning.
- Identification of instructors' pedagogical profile: Analysis of the educational profile of instructors and relationship of academic and social aspects with specific course modules.
- Personalized and humanized feedback: Provide tools to aid the instructors to create personalized feedback at scale [19], and setting up feedback systems that can capture student's emotions and provide motivational messages.
- Analytical process visualization: Visualization interfaces about the students' behavior in the interaction with the contents and activities.
- Course assessment: Collecting data on students' perceptions of methodology and course material.
- Dropout and Performance prediction: Performance prediction algorithms, integrated with student and teaching staff alert systems to identify students at-risk.

6 FINAL REMARKS

This paper presents the findings from a qualitative investigation of the possibilities for implementing LA in Brazilian higher education. Although the insights emerged from one Brazilian HEI and qualitative research does not aim for generalizability, our findings give

explanations for phenomena, which may be applied to HEIs that share similar contexts.

All participants agree on the potential of LA to help overcoming educational challenges, particularly in providing ways of promoting a personalized process, taking into account each student's context and specific needs; and allowing evidence-based pedagogical decisions. However, providing data is not enough: simple but powerful visualizations are needed, along with suggestions of pedagogical actions. LA solutions should help overcome the difficulties in students and teaching staff's access to information, caused by the LMS poor usability. Main risks envisioned (mainly by instructors) were the excessive intrusion of students' private space and the use of data to control teaching staff's work threatening their autonomy.

The findings presented in this paper, although limited to three stakeholder groups, highlight practical implications for the development of policies and guidelines on the adoption of LA, as well as point to several opportunities for the implementation of LA tools for the context investigated. For future work, we intend to interview institutional administrators, as well as conduct large-scale surveys (following the SHEILA project) to gain broader understanding of expectations towards LA among students, teaching staff and institutional leaders. We also aim to establish partnerships with other institutions in Brazil and Latin America to carry out a comparison study on needs and concerns about LA, so as to support the development of adoption strategies and policies that are pertinent to this regional context.

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